Stormwater TMDL for the Benthic Impairment in the Accotink Creek Watershed

Proposed Technical Approaches

First Technical Advisory Meeting
Fairfax County Government Center
Fairfax, Virginia
December 15, 2008

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

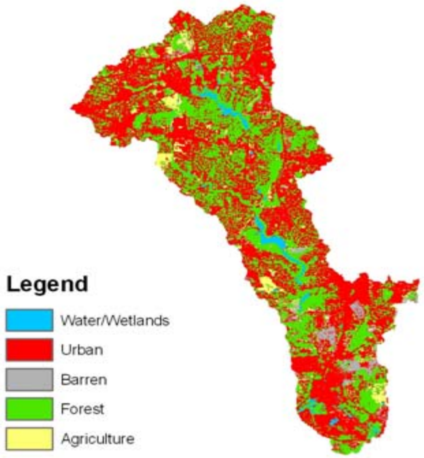
Agenda

- Presentation of Two Potential Approaches
  - Sediment Load Duration Curve Approach Linked to Flow
  - Impervious Cover Model Linked to Sediment Erosion Models and to Flow
- Next Steps

Urbanization and Loss of Aquatic Diversity

- **Changes to stream hydrology**
- **Physical alteration of the stream corridor**
- **Stream habitat degradation**
- **Declining water quality**
- **Loss of aquatic diversity**

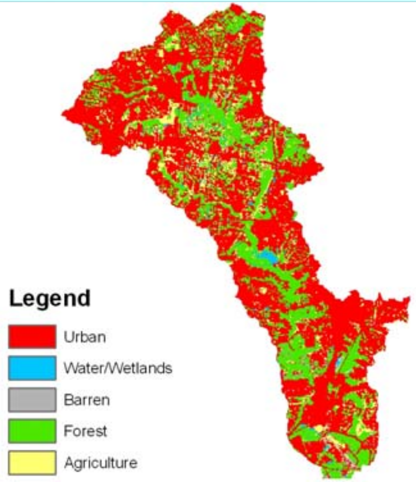
Urbanization in Accotink Creek Watershed



NLCD 1992

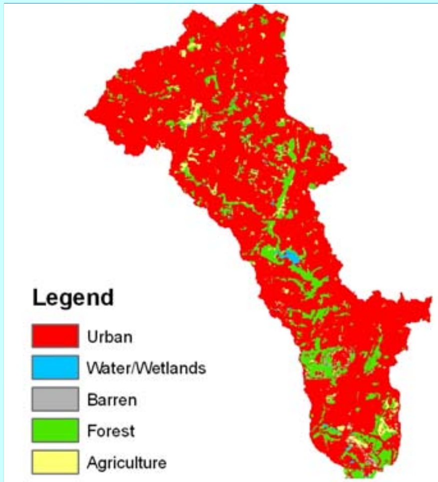
Land Cover Type	Acres	% of Watershed
Urban	16,131	52.2%
Water/Wetlands	615	2.0%
Barren	959	3.1%
Forest	11,482	37.2%
Agriculture	1,703	5.5%
Total	30,890	100.0%

The percent of developed area in Accotink Creek watershed has increased dramatically
from 52% (in 1992) to 83% (in 2005)



NLCD 2001

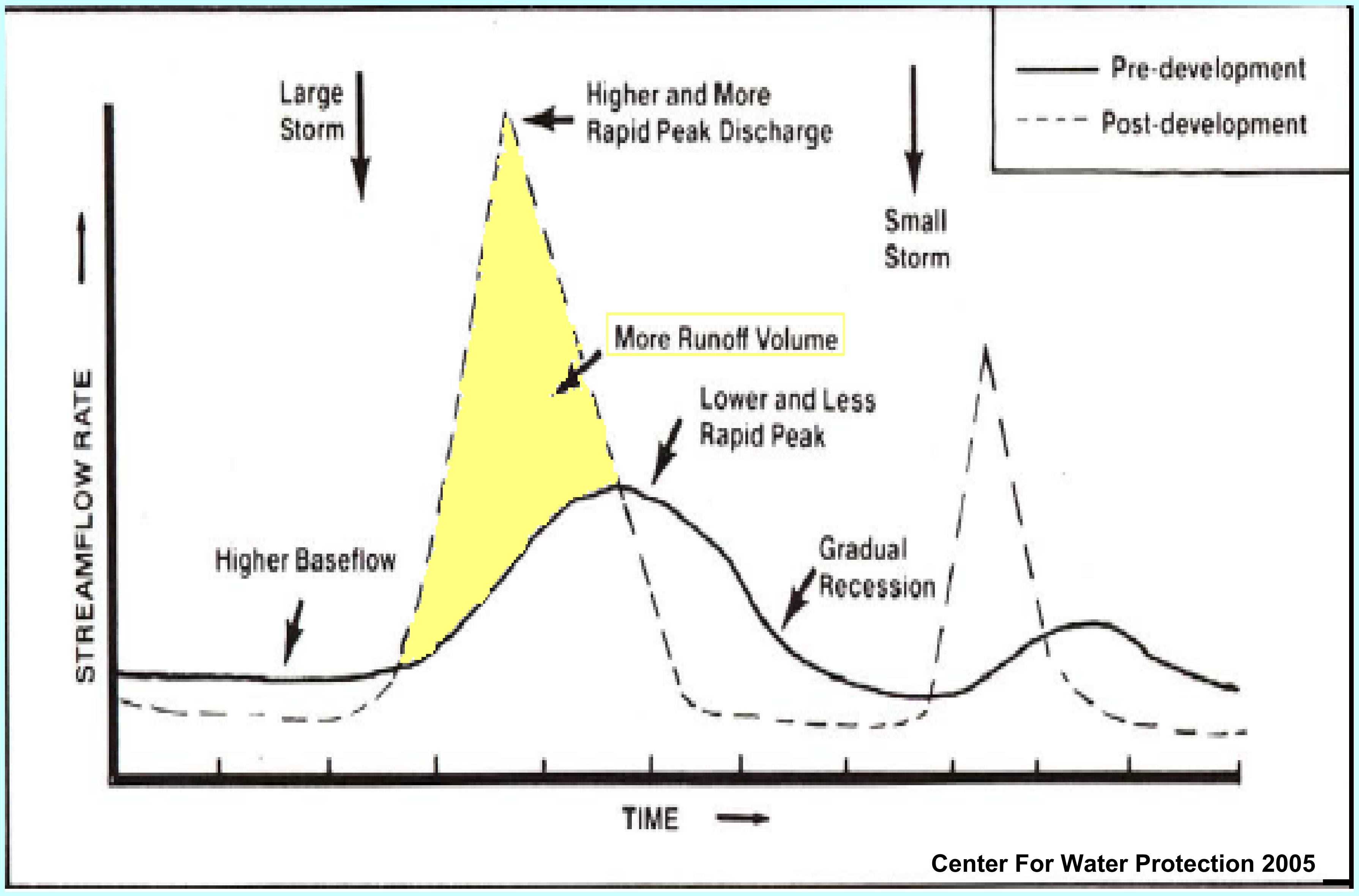
Land Cover Type	Acres	% of Watershed
Urban	19,010	61.5%
Water/Wetlands	407	1.3%
Barren	278	0.9%
Forest	8,386	27.1%
Agriculture	2,809	9.1%
Total	30,890	100.0%



NLCD 2001 - DOF 2005 Hybrid

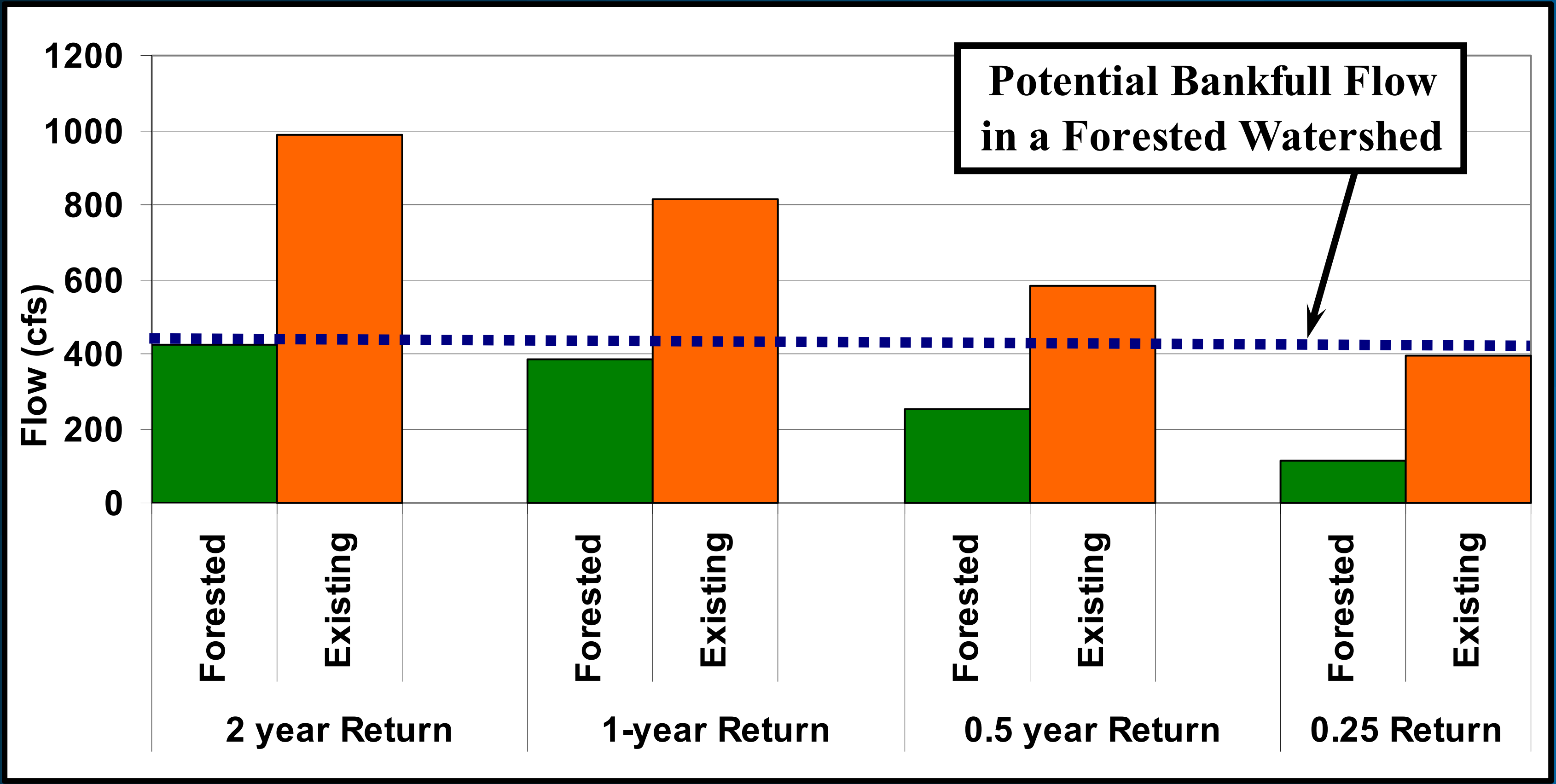
Land Cover Type	Acres	% of Watershed
Urban	25,708	83.2%
Water/Wetlands	172	0.6%
Barren	180	0.6%
Forest	3,768	12.2%
Agriculture	1,061	3.4%
Total	30,890	100.0%

Pre - and Post-Development Hydrographs



Center For Water Protection 2005

Peak Flows Comparison for Various Return Periods in Accotink Creek at the Fairfax City Limits Forested vs. Existing Conditions



Source: City of Fairfax, Watershed Management Plan (2005) prepared by the Louis Berger Group

Accotink Creek Degradation

Pictures - DEQ, February 2008

Preliminary Estimates of Existing Sediment Loads

Land based loads estimated using EPA BasinSim.

Sediment loads from developed lands were computed using median event mean concentration (EMC)

Instream erosion estimated using a spatial technique developed by Evans et. al. (2003)

Source	Sediment (tons/yr)	(%)
Barren Land	120	1.4%
Forested Land	18	0.2%
Pasture/Hay	97	1.1%
Cultivated Crop	282	3.3%
Developed, Low intensity	295	3.5%
Developed, Med Intensity	448	5.3%
Developed, High Intensity	242	2.8%
Developed, Open Space	10	0.1%
Instream Erosion	**6,969**	**82.2%**
Total	8,481	100 %

Instream Erosion accounts for more than 80% of the total Sediment Load

Sediment Load Duration Curve Approach Linked to Flow

Use a widely adopted method to:

- **develop correlations between stream flow and total suspended sediment (TSS) observations in the impaired and non-impaired segments.**

- Using this inherent relationship, the required reduction of sediment load and stormwater volume can be determined

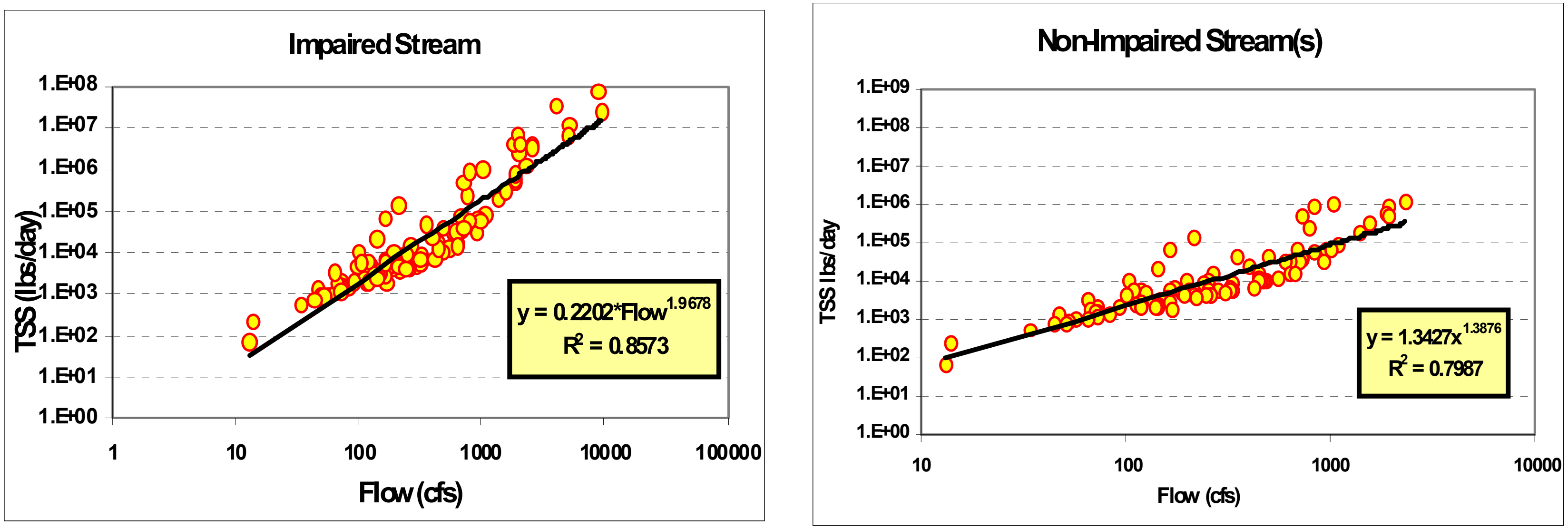
Sediment Load Duration Curve Approach Linked to Flow

First Step: Develop Sediment Rating Curves for the Impaired and non-impaired Stream(s)

- Criteria for selection of non-impaired stream(s) :

  Similar Stream Order

  Same Ecoregion Availability of TSS and Flow Data

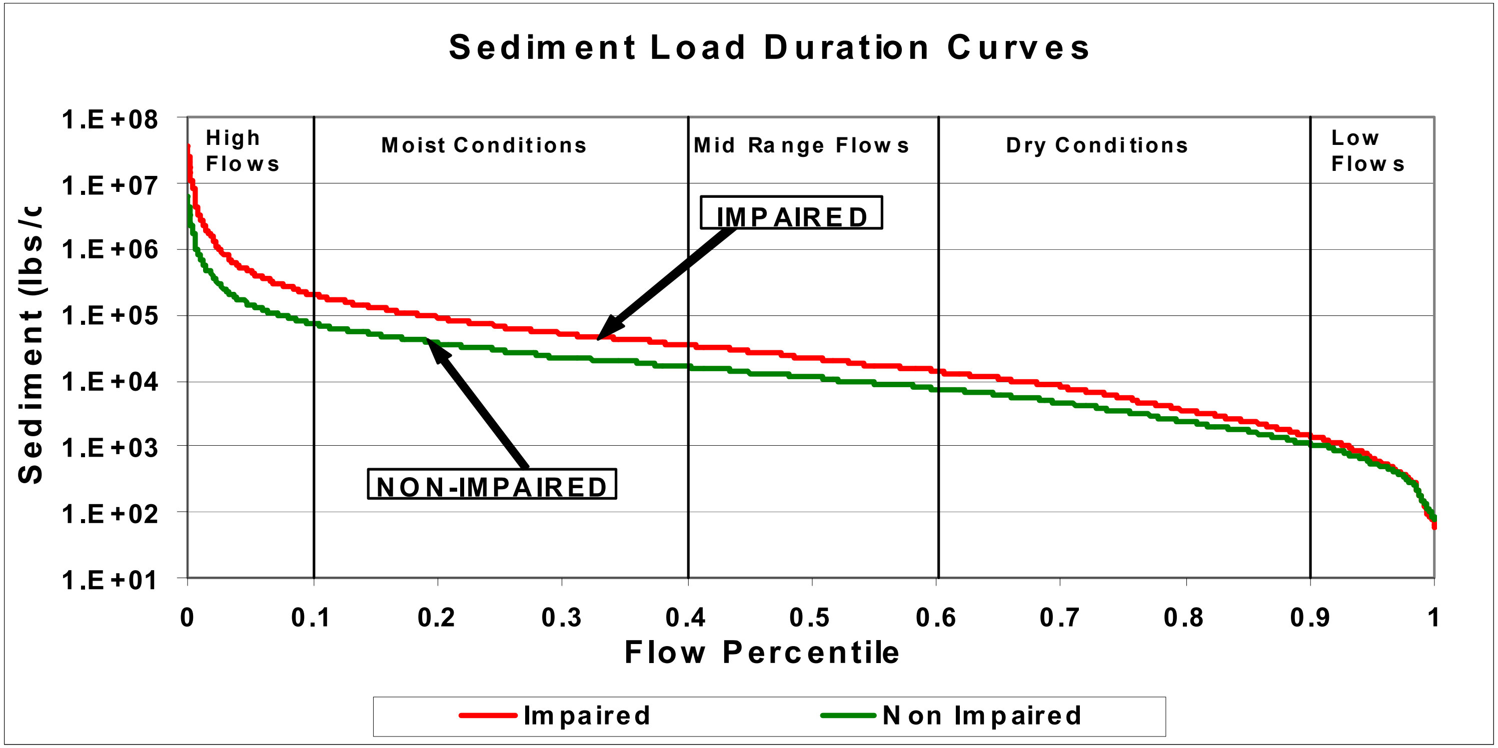


Hypothetical Sediment Rating Curves for Impaired and non-Impaired Streams

Sediment Load Duration Curve Approach Linked to Flow

Second Step: Develop Sediment Load Duration Curves (LDC) for the Impaired and non-impaired Stream(s)

- Sediment LDC characterizes sediment loads at different flow regimes



Hypothetical Sediment LDC for Impaired and non-Impaired Streams

Sediment Load Duration Curve Approach Linked to Flow

Third Step: Identification of the Required Overall Sediment Reduction

- Identify the critical Flow regime
- Estimate the Land-based Sediment Loads from Non-Urban Areas Using the Generalized Watershed Loading Functions (GWLF) Model
- Estimate the Land-based Sediment Loads from Urban Areas Using Literature Values (NALMS, NURP, EPA)
- Estimate the Sediment Loading from Instream Bank Erosion Using a Spatial Technique by Evans et al. (2003)

Sediment Load Duration Curve Approach Linked to Flow

Fourth Step:

- Link the Estimated Overall Sediment Yield (Land-based and Instream Bank Erosion) to the Accotink Creek Sediment LDC to identify the corresponding sediment load reduction
- Estimate the Volume of Water and Identify the Required Overall Volume of Stormwater Reduction, Using the Sediment Rating Curves <u>or</u> Flow Duration Curve (FDC)

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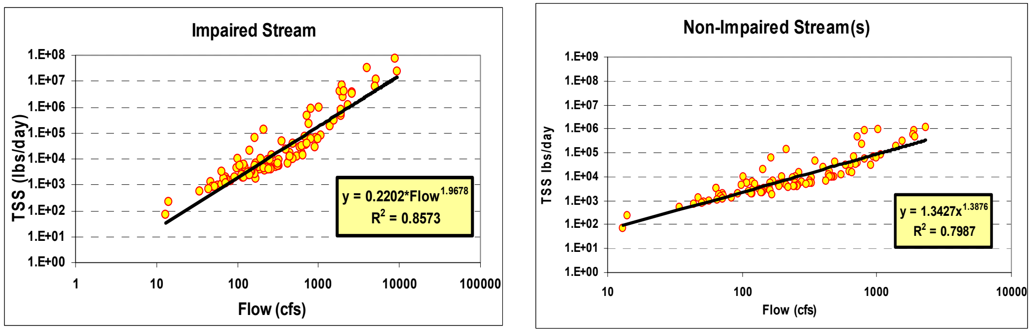
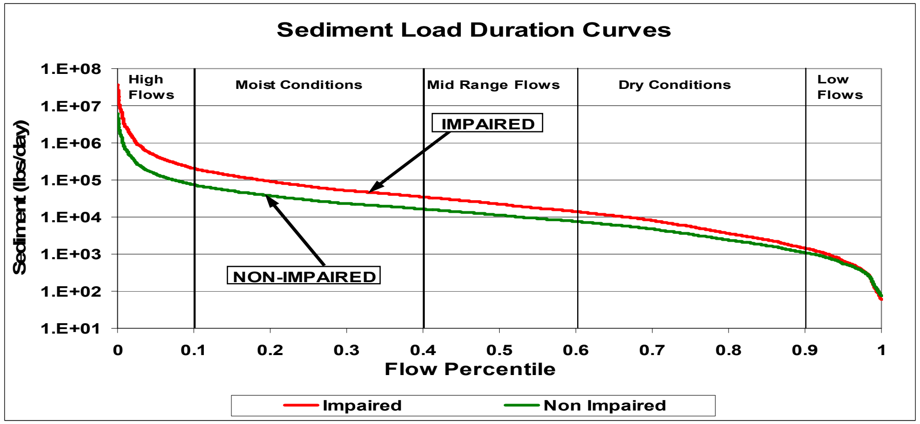


Hypothetical Sediment Rating Curves for Impaired and non-Impaired Streams



Hypothetical Sediment LDC for Impaired and non-Impaired Streams

Apply the GWLF model (land based erosion) and the Evans equation (instream erosion) to the Accotink Creek watershed

Estimate the overall simulated sediment yield and the sediment yield by source

Compare the overall simulated sediment yield with the yield from the impaired sediment load duration curve to identify the required sediment reduction

Use the required sediment reduction and sediment yield by source to develop the initial load allocations

Use an area-weighted approach to allocate for the MS4s

Develop Waste Load Allocations

Assign an MOS following VADEQ Guidance

Develop TMDL

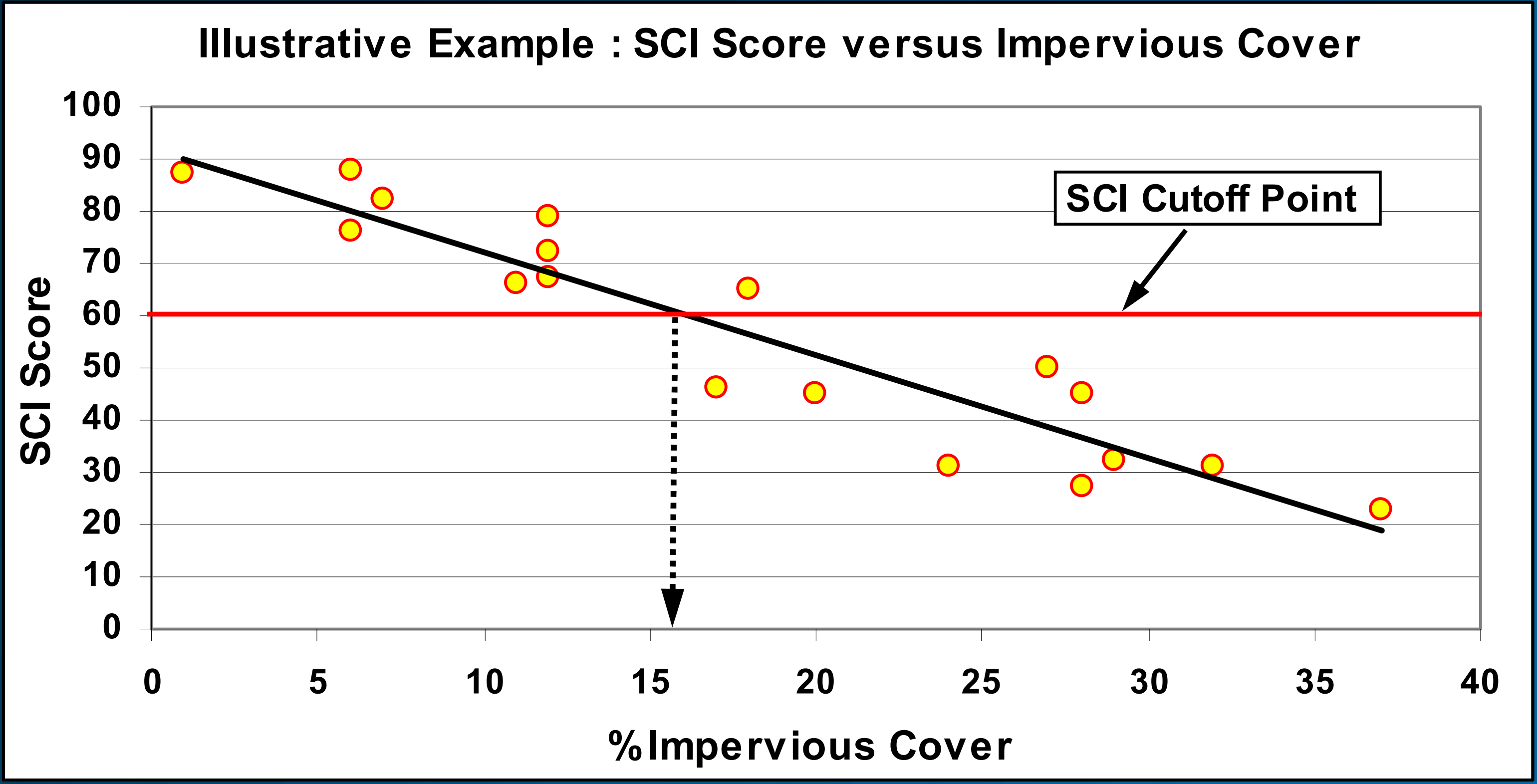
Impervious Cover Model Linked to Sediment Erosion Models

- Use the impervious cover (IC) as an indicator of urban watershed degradation
- Establish relationship between Impervious Cover (IC) and stream health
- Use this relationship to identify the IC endpoint for healthy streams
- Link the IC in Accotink Creek and the IC endpoint to sediments and stormwater flow
  - ➢ The use of IC as a measure for urban watersheds degradation is not new; Over 200 Scientific Articles in the last 20 years show that IC is an excellent indicator of development impacts- (*CWP 2003, Connecticut DEP 2007)*

Impervious Cover Model Linked to Sediment Erosion Models

First Step: Establish and Develop the TMDL Endpoint for Impervious Cover specific to Northern Virginia Using

- All available SCI scores
- IC data (if possible effective IC) in urban watersheds and non-impaired streams for the area



Impervious Cover Model Linked to Sediment Erosion Models

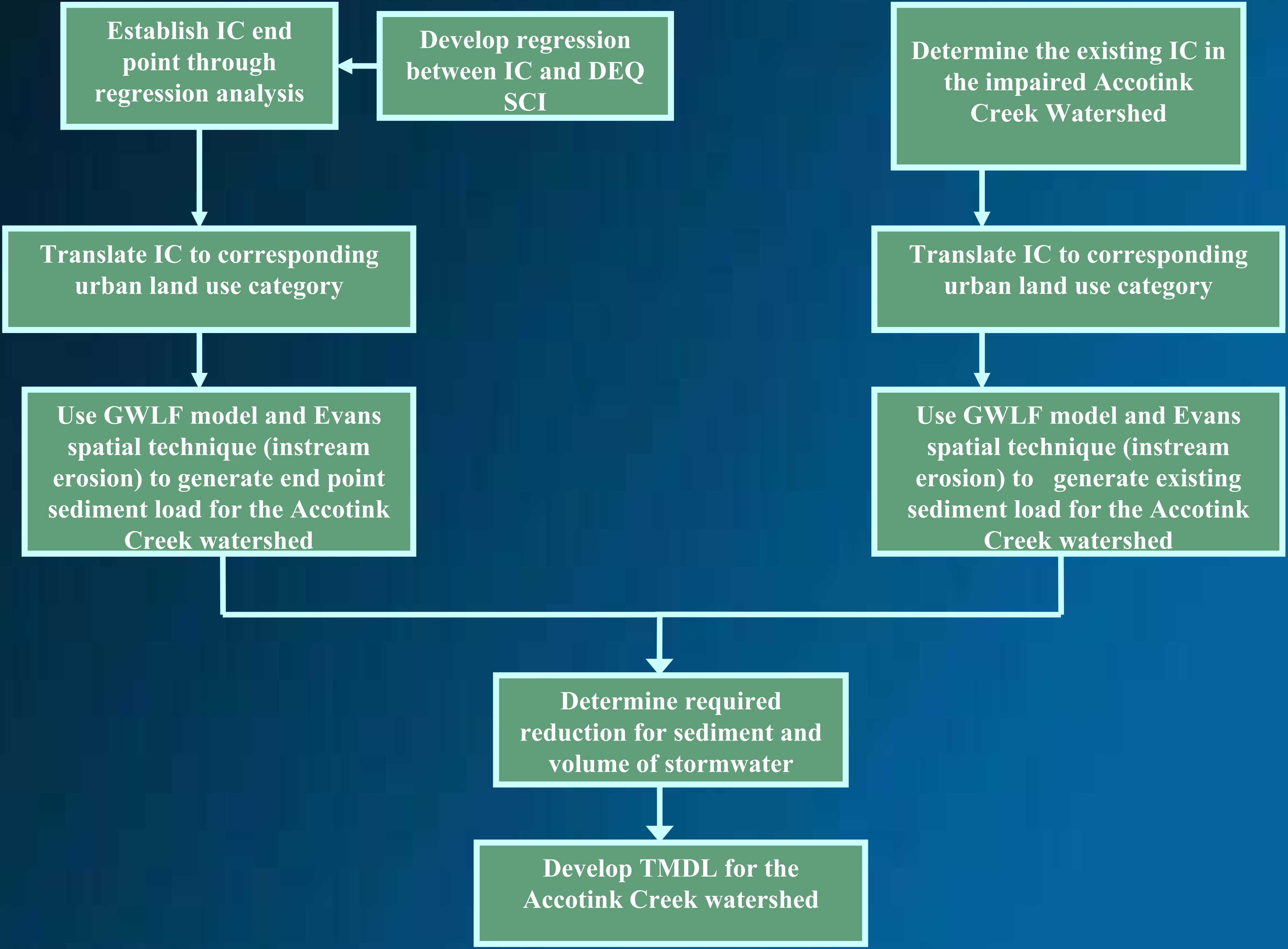
Second Step: Estimate the Overall Sediment Yield in Accotink Creek under Existing and IC Endpoint Conditions

- Estimate the Land-based Sediment Loads from non-urban Areas Using the Generalized Watershed Loading Functions (GWLF) Model
- Estimate the Land-based Sediment Loads from Urban Areas Using Literature Values (NALMS, NURP, EPA)
- Estimate the Sediment Loading from Instream Bank Erosion Using a Spatial Technique by Evans et al. (2003)
- Calculate the Required Sediment Load Reduction Based on the Difference between Existing and IC Endpoint Conditions

Impervious Cover Model Linked to Sediment Erosion Models

Third Step: Estimate the Volume of Water to Identify the Required Overall Volume of Stormwater Reduction

- Establish Flow Duration Curves (FDC) for existing conditions (observed stream flow) and endpoint IC conditions (predicted flow - GWLF)
- Determine the required stormwater reduction based on the difference between both FDCs at the flow regime that corresponds with sediment yield generated in GWLF and the instream model



Establish IC end point through regression analysis

Develop regression between IC and DEQ SCI

Determine the existing IC in the impaired Accotink Creek Watershed

Translate IC to corresponding urban land use category

Translate IC to corresponding urban land use category

Use GWLF model and Evans spatial technique (instream erosion) to generate end point sediment load for the Accotink Creek watershed

Use GWLF model and Evans spatial technique (instream erosion) to generate existing sediment load for the Accotink Creek watershed

Determine required reduction for sediment and volume of stormwater

Develop TMDL for the Accotink Creek watershed

Conclusions

- Either approach can be used for the development of the benthic TMDL in Accotink Creek
- Both approaches have been used in developing similar TMDLs
- Both approaches are based on good science
- Option 2 (IC Model) can address stormwater flow without the link to sediments

Next Steps

- Finalize Technical Approaches
- Plan for 1st Public Meeting
- Draft Modeling Approach Technical Memorandum
- Develop TMDL Allocations
- Draft TMDL Report

Questions ?